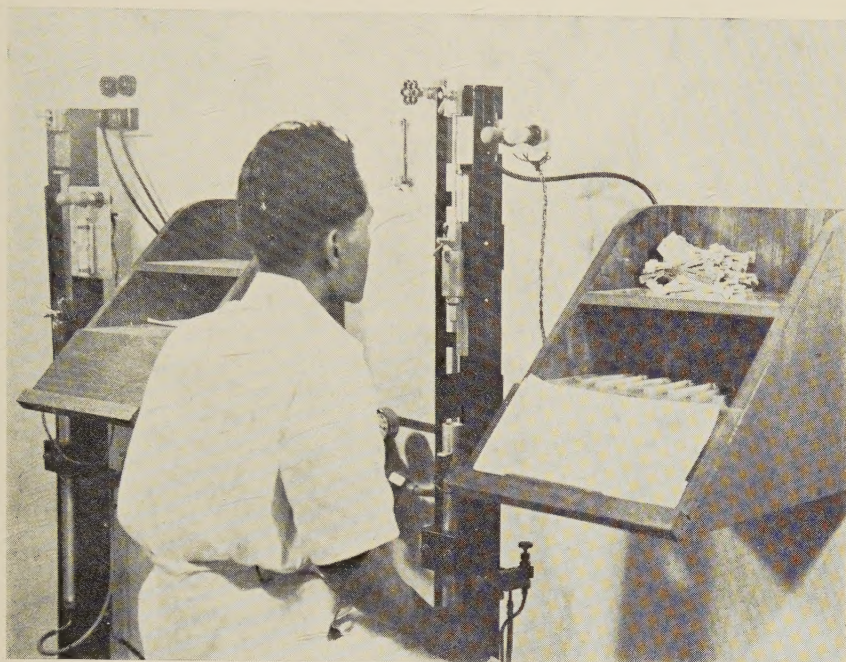


Root disease control P. 32

PLANTERS' BULLETIN

OF THE RUBBER RESEARCH INSTITUTE OF MALAYA



PLANTERS' BULLETIN THIRTYFIVE

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Price
50 Cents



March
1958

R R I

LOCATION. The institute's laboratories and offices at the third mile, Ampang Road, Kuala Lumpur are open from 8 am to 1 pm and 2 pm to 4 pm on Mondays to Fridays, and from 8 am to 12.30 pm on Saturdays.

EXPERIMENT STATION AND FACTORY. This station of the R R I is situated 16 miles from Kuala Lumpur, at Sungei Buloh on the Kuala Lumpur — Kepong — Kuala Selangor road. Visits may be made on Mondays or Wednesdays by arrangement. There is a guest house.

CORRESPONDENCE. All LETTERS must be addressed to the Director, Rubber Research Institute of Malaya, Post Office Box 150, Kuala Lumpur. Special inquiries may be marked for the attention of particular officers. The address for TELEGRAMS is Searching, Kuala Lumpur. TELEPHONE: Kuala Lumpur 3351. PARCELS occasionally arrive without any indication of their origin. Senders' names and addresses should be written clearly on the outside of all packages, and advice of despatch should be given by letter or telegram.

PROHIBITED PLANT SPECIMENS. Attention of planters and others in territories outside the Federation of Malaya and the Colony of Singapore is drawn to the Malayan Plant Importation Rules which prohibit the importation into Malaya of any part of a plant, whether living or dead, unless it is accompanied by a permit issued by the Director of Agriculture, Federation of Malaya. No permit will be issued in respect of any diseased plant or any plant pest. Any plant imported in contravention of these Rules (whose object is to prevent the introduction of diseases or pests) will be destroyed without examination. Any one outside Malaya who desires our advice on any matter that may require examination of living material must first inquire by letter.

ADVICE. Inquiries are invited from rubber producers in the Federation of Malaya, the Colonies of Singapore and North Borneo, and the territories of Sarawak, Brunei and Nigeria, who may require more detailed information applicable to their own special problems. Where it is considered necessary, visits will be made to estates in Malaya as convenient. Visits to estates in other territories are by special arrangement. The only visits for which charges are normally made are those of our clone identification inspectors. INTERVIEWS should be arranged by letter, as members of the senior research and advisory staff are frequently absent on visits to plantations.

PUBLICATIONS. Subscription to all or any of our series of publications (*Planters' Bulletin*, *Journal*, *Reports*, and miscellaneous booklets) may be made by depositing \$15 with us. An annual statement of account will then be submitted. We are unable to give annual subscription rates or any form of discount, but for multiple subscriptions a lower rate of initial deposit is acceptable. Postage is charged on oversea mailings. A list of 'Publications of the RRI' is available on request.

PLANTERS' BULLETIN

OF THE RUBBER RESEARCH INSTITUTE OF MALAYA

Kuala Lumpur

March 1958

Number 35

Editorial: Ninth Pacific Science Congress

In November over five hundred foreign scientists from more than forty countries in the Pacific area attended the Ninth Pacific Science Congress, held in Bangkok under the patronage of Their Majesties the King and Queen of Thailand. Excellent facilities were provided at the meeting place, Chulalongkorn University, whose Rector was President of the Congress. Leading scientists from countries outside the Pacific area were invited as official guests. The wide range of studies was matched by the many nations represented. There were nearly twenty sections which met each day to discuss the papers contributed, thus no delegate could cover more than a small part of the whole. The R.R.I. representatives presented the only papers dealing directly with rubber planting and processing, but several of the symposia bore upon problems of general interest to the industry. It is from these that we have drawn in outlining some of the subjects discussed and the views expressed at the Congress.

In a public lecture preceding a symposium on 'climate, vegetation, and rational land utilisation in the humid tropics' the audience was reminded that world population is about 2,700 million and the net annual increase is estimated at 1.3%. Although some countries still have adequate reserves of land suitable for cultivation, others are already utilising most of their resources. The production of food and raw materials such as fibres and rubber, and the extraction of minerals, make pressing demands on land. The needs of industry, housing, recreation, communications and defence must also be met.

Experience has shown that, in the tropics, land management must be of a high order to prevent soil erosion and degradation. Careful planning is needed to combine measures of conservation, such as maintaining forest reserves, with schemes for land development. The exercise of control over the use of a country's land, though sometimes regarded as an infringement of liberty or as a relic of a colonial administration, is a mark of good government which it is the duty of all to support. Technical aspects of the subject were dealt with in contributed papers on the subjects of the analysis of climate, classification of soils, surveying vegetation and land use, and the mapping and correlation of these features.

The tropical forest is the richest of the earth's vegetation, valuable not only as a source of timber but also in conserving the soil. It is

a repository of a wide range of plant types, from which some major crop plants have been derived, and from which others may be discovered to yield products of value, such as new drugs. In recent years there has been a strong revival of interest in medicinal plants, as was indicated by a lengthy discussion in the chemical section of the Congress on plant alkaloids.

The advances of medical science have had a profound effect on population increase, which threatens to overtake possible increases in agricultural production. It was felt that the time had come to present the facts clearly to the public and their administrators. Malaya was not discussed specifically in this connection; however, with a population of six and a quarter million rising by 3% per annum there should be no squandering of natural resources despite the present large reserves of land. The rubber industry must play its part in improving the value of land already held, by effective replanting; fitting, with forestry, into a pattern of future land use that leaves the most fertile soils for food cultivation.

There were two R.R.I. contributions to the botanical section of the Congress, briefly reviewed in our last issue. Dealing with yield stimulation and with the vegetation of rubber estates, they were presented at symposia on plant physiology and the botany of agricultural plants and weeds. Another symposium was concerned with the difficulties facing all botanical institutions in the tropics, most of which stem from shortage of trained and experienced staff, affecting not only botanical gardens museums and herbaria, but also research stations in the applied fields of forestry, agriculture and fisheries. It was urged that fundamental work, such as taxonomic research, is an essential basis for the economic development of natural resources. At present few of the leading specialists in any field are working in the tropics. Some institutes have arranged exchanges to give opportunities for specialists in other parts of the world to study tropical problems, and for those in the tropics to become acquainted with methods perfected elsewhere. These visits should be long enough for the visitor to undertake actual work on a problem. Fruitful as brief meetings and exchanges of ideas may be, they are no substitute for practical experience, either for the specialist advisor or for the student. The main obstacle to an extension of these exchanges is shortage of funds.

One of the entomological symposia was devoted to insecticides. Concern is often expressed about the possible hazards of using modern insecticides on a large scale; there are sometimes sensational press reports by those who seek to have the use of certain chemicals banned. Yet thousands of tons of D.D.T. have been used over recent years, without a single case of death or serious illness among people exposed to the insecticide, except where large amounts have been ingested deliberately or by mischance. Important benefits have accrued in the medical sphere, through the control of insect vectors of disease, and in the agricultural

sphere, through the control of pests of crops in the field and of food in storage. A paper contributed by the R.R.I. reported how aldrin and dieldrin especially provide far more effective control of the rubber tree termite than was obtained with the poisons used before which entailed a greater risk to users.

No differences in the incidences of a wide range of diseases – from hay fever to cancer – have been found when populations using insecticides on a large scale have been compared with those which do not. Even so, applications of insecticides in large quantities have attendant risks. Fish may be killed, though instances where the fish population has been seriously and permanently reduced are rare. Beneficial insects – predators of insect pests and pollinating insects – have sometimes suffered, though these ill effects can be minimised by careful timing of applications, and there is also some promise of finding selective insecticides. Nevertheless, the ‘balance of nature’ may sometimes be adversely affected by the use of insecticides. It should be borne in mind that the balance is to some degree disturbed by establishing any cultivation, most of all a large scale plantation crop. If a pest becomes locally abundant, the aim is to employ insecticides to strike a more favourable balance.

The only paper on rubber in the symposium on ‘chemistry in the development of natural resources’ was the R.R.I. contribution ‘Improved Natural Rubber’. It was of general interest because it showed how a natural product is being improved to compete with synthetic substitutes. From other contributions it was useful to learn of ways in which other industries prevent spoilage of their products by oxidation and bacterial action, and to relate these findings to the methods used in the rubber producing industry. Volatile fatty acid numbers (as applied to latex) are used to assess quality in sauce manufacture, and deep-sea fish are kept fresh in ice containing small amounts of antibiotics, which also suppress the growth of bacteria in latex.

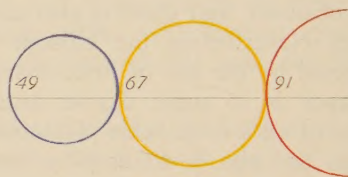
The Congress demonstrated how scientists of many nations, tackling a wide range of problems, can be helped to overcome one of their greatest difficulties – the exchange of ideas and information. Much remains to be done. One step being taken is the preparation of bibliographies of selected subjects by committees of the Congress. The improvement of facilities in museums and libraries was also discussed. It was recognised that the wider problem of reaching the general public, on whom the application of the results of scientific work and support for its further extension so much depend, is largely unsolved.

The Thai scientists and organisers were deservedly congratulated and warmly thanked for their efforts as hosts, making the Congress so successful and enjoyable. The personal contacts made during the meetings and the excursions afterwards could not fail to strengthen the feeling of unity in the cause of applying science to the common good.

Technical Classification of Natural Rubber

TECHNICALLY CLASSIFIED (TC) NATURAL RUBBER is rubber of any existing International Grade on which additional information about its technical properties has been obtained. When technical classification was first introduced, early in 1951, two technical properties were measured, and, depending on the values recorded, a consignment of rubber fell into one of three classes for each property. There were, therefore, nine classes in all. One property characterised was the ease of breakdown of the raw rubber in manufacturing, and was indicated by a line, circle or cross on the bale, for soft, medium or hard rubber respectively. The second property characterised the behaviour of the rubber during vulcanisation in a standard formulation, and was indicated by the colour of the symbol—red for slow curing, yellow for medium curing, and blue for fast curing rubber. This was, in all essentials, the scheme first propounded by French research workers in 1949.

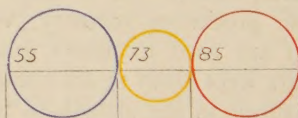
Old limits — classes of unequal range for both producers and consumers



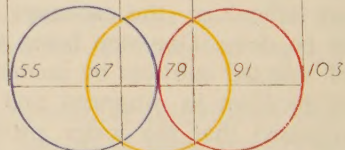
Less than two years after the scheme had come into operation, it was found that the classification on the ease of breakdown of the raw rubber was unreliable and misleading. It was promptly discontinued, leaving only the circle in three colours as the TC symbol. Hence, since January 1953, technical classification has meant the division of natural rubber into three classes: Red Circle, Yellow Circle and Blue Circle, depending solely on the vulcanisation characteristics of the rubber.

Limits since January 1954 — new classes of unequal range for producers, and of equal range for consumers

Producers' limits



Consumers' limits



A year later the sharp dividing lines between the three classes were removed by the introduction of overlapping class limits to enable the classification of borderline rubber (*Planters' Bulletin 10*, issued in January 1954). Rubbers with values of the measured property on the border of two classes had previously remained unclassified, as they could not be put in one or the other class without a high percentage of

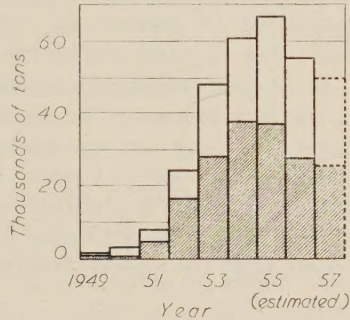
mis-classification. The innovation of overlapping limits reduced mis-classification by giving producers a safety margin, inasmuch as the producers' (marking) limits were narrower than the consumers' (acceptance) limits. This is illustrated in the diagram, in which the scale is of values of strain, and the circles have no significance except to indicate the limits of the ranges referred to.

With these modifications, natural rubber is today being classified in four of the producing territories, namely Malaya, Indonesia, Cambodia and South Vietnam. Although testing facilities are also available in Thailand and Ceylon, no TC rubber has been marked in these countries up to the present time. The histogram shows the total world output of TC rubber since the inception of the scheme, the shaded area being the production for Malaya. Estimated figures for 1957 are indicated by dotted lines.

The availability of TC rubber gave consumers a technical knowledge of their raw material, albeit based on one property (strain), enabling them to dispense with much preliminary blending and control testing. Small manufacturers could now compete better with larger manufacturers, and could choose rubbers for special purposes. The producers, in presenting a technically known rubber, were providing a service to consumers with the object of meeting one of the rubber manufacturers' most bitter complaints – variability in curing characteristics – and were thereby combating the competition of synthetic rubber, which has always been marketed on technical specifications.

The table (taken from *Rubber World*, September 1956, page 888), gives some idea of the potential demand for TC rubber in the U.S.A.

WORLD AND MALAYAN
OUTPUT OF TC RUBBER



WORLD SUPPLY VS. U.S.A. DEMAND FOR TC RUBBER

Description	Supply					Total world supply	Potential U.S.A. demand
	Malaya			Sumatra	Indo-China		
	Estates	Packers	Re-millers				
RSS 1 & ADS	33,334	1,602	—	10,816	16,604	62,356	16,894
RSS 2,3,4 & 5	—	1,390	—	—	—	1,390	42,155
Pale crepe	263	—	—	—	—	263	1,566
All grades of brown crepe	536	—	548	2,111	213	3,408	34,967
Totals	34,133	2,992	548	12,927	16,817	67,417	95,582

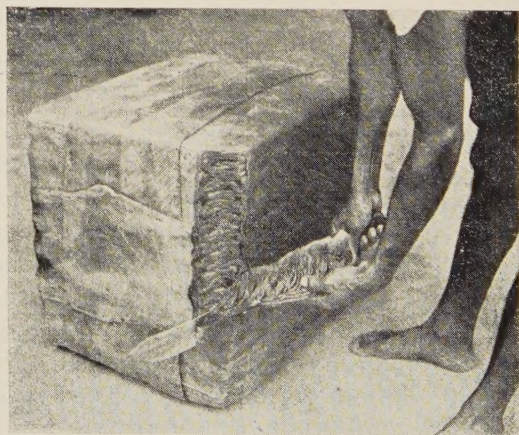
if all grades were freely available at no extra cost. The disparity between supply and demand is at once apparent both in quality and quantity. Much more lower grade TC rubber is alleged to be needed than is at present produced.

The technical classification scheme is applicable to all grades of natural rubber and there is no technical difficulty in classifying larger quantities of lower grade rubbers. The difficulty arises from the small profit margins in producing these grades in remilling factories, which cannot sustain even the small incidental expenses involved in testing the rubber. Thus we find only the more progressive estates and those concerned with the overall good of the producing industry co-operating in the scheme. Packing houses in Malaya classify consignments against firm orders for TC rubber, but remilling factories which used to classify a little have dropped out within the last two years.

In Malaya, technical classification is carried out by the R.R.I., and in the laboratories of the Socfin Company Limited, in Kuala Lumpur. There are three test stations in Indonesia, two in Indo-China, one in Thailand and one in Ceylon. Once every year, check tests are carried out by all these test stations on samples distributed by the R.R.I. of Malaya, as the co-ordinating institute, to ascertain the differences in the results from the various laboratories.

TESTING PROCEDURE

The procedure for classifying estate rubber, which comprises most of the TC output, has been given in detail in an article in *Planters' Bulletin* 2. We here briefly recount some of the main points. A sample for test is taken from bales as shown in the photographs, cut with a dry knife from the corner of a bale and along its height, so that it includes a portion of as many sheets as possible. A well cut sample is about a $2 \times 2 \times 3$ inches triangular section 19 inches long, weighing 2 lb, which is sent to the R.R.I. in one of the bags provided, labelled with the date of harvesting and date on which the sample was taken. Wrapping sheets equivalent in weight to the sample removed are then spiked over the cut corner of the bale, to repair it and make it up to weight. The repair is more effective if carried out before talc is applied to the bale.



*Sample cut
almost complete.*

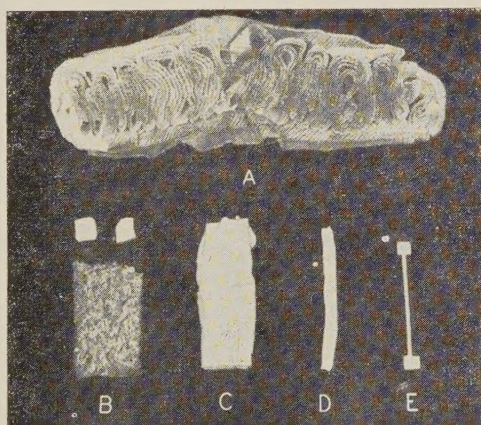


*Repaired bale and
labelled sample bag.*

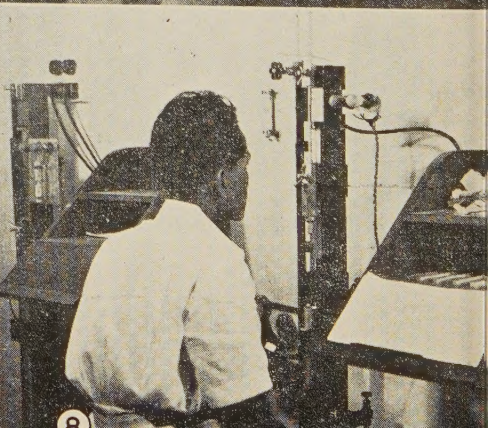
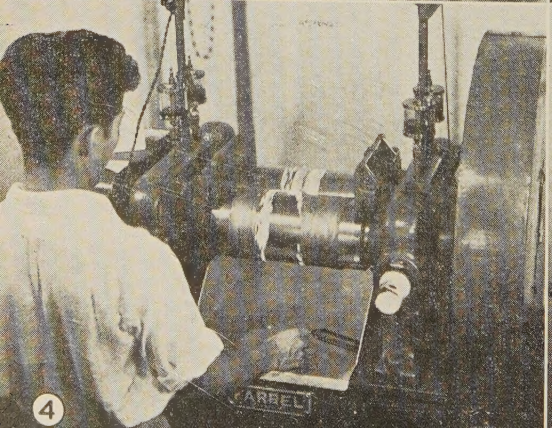
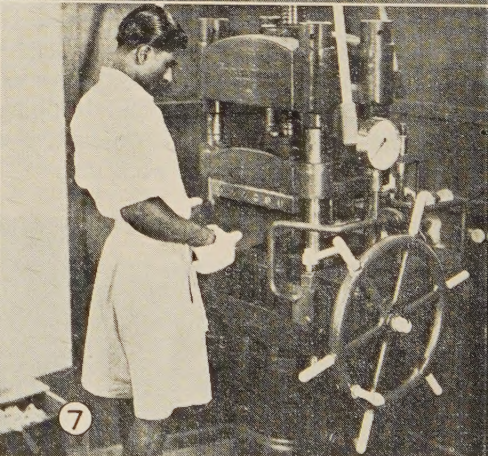
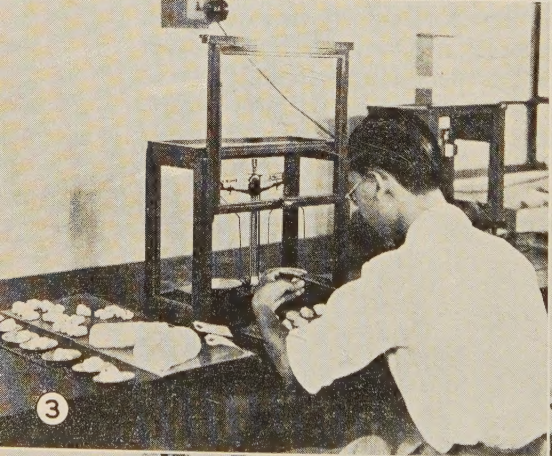
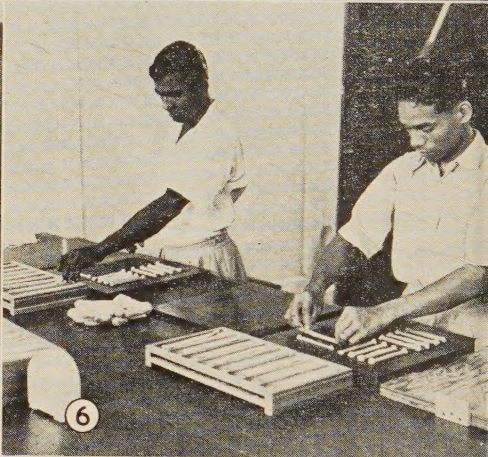
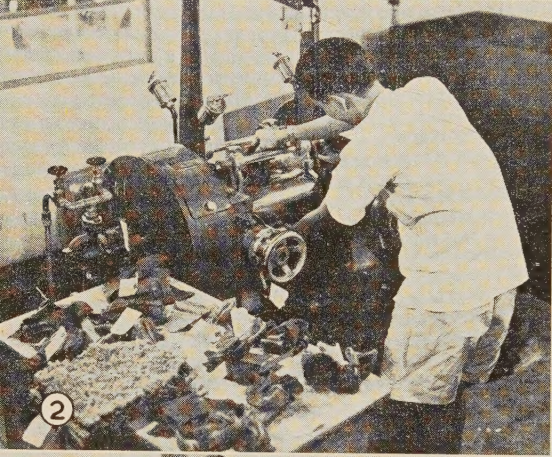
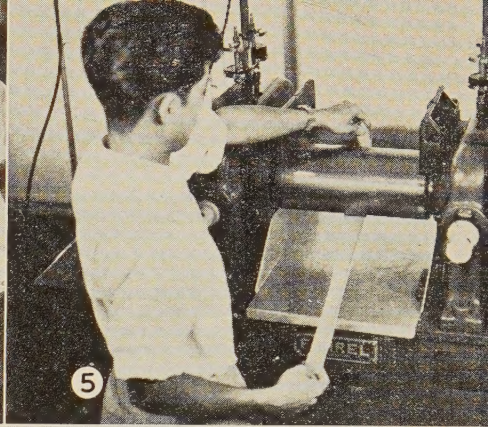
When an estate first enters the scheme, a sample has to be sent from every bale produced for two consecutive days (if the estate is tapping alternate daily) and thereafter for eight days in succession, from one bale taken at random from every ten bales produced, but not less than two bale samples each day. The procedure is changed for estates with different tapping systems, to include samples from all parts of the estate crop. The level of the estate's production, and its variability, are thus established.

If, as a result of tests performed, the estate's production is deemed to be sufficiently uniform to permit classification, the appropriate symbol (Red, Yellow or Blue Circle) is assigned to its production and the estate may, until informed otherwise, use the symbol on all future bales of that particular grade produced. If the production is not uniform enough, changes in preparational procedure are recommended to help reduce variability. Once an estate has started to classify its production, however, it must continue to send samples regularly every week from 10% of all bales produced, but not less than four samples a week; these, on the alternate daily tapping system employed on most estates, being taken from two consecutive days' production at the rate of two random bale samples each day.

- A *Sample as received.*
- B *Part of blended sample, with compounding ingredients.*
- C *Compounded stock after mixing.*
- D *Part of C cut to fit mould for curing.*
- E *Test piece.*



From rubber sample to test piece for strain evaluation.



At the test station the wrapping sheet is removed (1) and the remainder homogenised by passing it through a cold mill (2). The necessary compounding ingredients are added in the form of two masterbatches (3) to a weighed portion of the blended sample (4), which is then mixed on a hot mill in a standard mixing cycle (5). The compound stock is left 24 hours to mature. A portion of the stock is cut out and loaded into one of sixteen cavities of a mould (6) for curing under heat and pressure for 40 minutes at 140°C (7). When the mould is unloaded the resulting test specimens have a dumb-bell shape. These are again left for 24 hours before testing (8).

NORMAL AND RAPID TEST

The strain test itself consists in clamping the specimen so that it is fixed at the upper end, hanging a kilogramme weight at the other end and measuring the percentage extension after one minute in free suspension, indicating the extent to which the raw rubber has reacted with the chemicals in the fixed curing time of 40 minutes. A large strain value (or low modulus) indicates a slow curing or Red Circle rubber, whereas a Blue Circle rubber is fast curing and hence will give a low strain (or high modulus) value. The bulk of the present Malayan output of TC rubber has medium vulcanising properties and falls into the Yellow Circle class.

The whole test normally takes about three days, involving as it does a 24-hour period of waiting between mixing and vulcanising, and again between vulcanising and testing. Such waiting periods are standard practice in the physical testing of rubber compounds, but, by dispensing with them, results can be obtained in about three hours. The strain values obtained are not the same, but a correlation has been established between the normal and the rapid tests.

The rapid test is invariably used when results are wanted urgently, as for packing house samples. Since packing houses always classify their production by lots, the sampling procedure is also somewhat different from that of estates. For each lot a packing house is required to submit random samples taken from 10% of the bales. The classification symbol is assigned to that particular lot on the mean of strain values obtained, provided, of course, that the variability is within certain specified limits.

There are thus, in effect, two separate sampling procedures, two separate testing procedures, two separate marking procedures; one for estates, where bale marking is prospective, the other for packing houses, with retrospective marking. The output of estates can also be classified by lots if representative samples are sent for testing; the classification results being obtained by the rapid method, and the estate being promptly advised, would enable the rubber tested to be marked before despatch. Attention is now being given to this procedure, which may be preferred on some estates.

Technical Classification of Natural Rubber

LEVEL CHANGING

Uniformity of production is secured mainly by blending the rubber according to certain recommended procedures and by level-changing techniques. Treatment with Fixanol VR (an I.C.I. product) to make rubber 'harder', or faster curing, is now established as a standard method and costs about 0.1 cent per lb of rubber produced. Red Circle rubber, which is little in demand, can thus easily be brought into the Yellow Circle class; similarly the latter, if necessary, can be changed to Blue Circle by the same treatment. No method has yet been standardised for the reverse conversion from Blue Circle to Yellow Circle, but current research encourages the hope that recommendations can be made in the near future.

APPRAISAL

The true function of technical classification by viscosity and by strain values of the vulcanised rubber can now be seen in its proper perspective. Whereas it commenced as a method of technically sorting natural rubber into nine classes, it is now becoming a method of producing technically uniform rubber of a single class. Indications are that Yellow Circle rubber will predominate, with smaller amounts of Blue Circle and much less Red Circle rubber, made on demand. Classification would logically include natural rubber of all grades as there is no difference in sampling and test procedure, although no simple means of level-changing is envisaged for packing house rubbers. It might be mentioned in passing that classification on the basis of dirt content, although it could be included in the TC scheme, is technically quite a separate problem.

In an assessment of the worth of technical classification of natural rubber, the changing pattern in the sources of raw material for rubber manufacture must not be left out of account. The scheme was a counter to the post-war threat of synthetic rubber, which has always been sold to specification. When natural rubber held a virtual monopoly, preliminary blending, necessitated by unknown variations within R.M.A. grades, was accepted factory practice at the consumers' end. If technical classification has not yet made much headway, and the initial interest in it has waned, it is because factory processes are still geared to such blending; but it may become obsolete, with large manufacturers in Europe as well as in the U.S.A. using synthetics in steadily increasing quantities. Then, if natural rubber is to compete with synthetics, it must be amenable to treatment without blending. This requirement can be met only by technical classification; and only by an extension of technical classification can the natural rubber producers offer to manufacturers what synthetics already provide in a big way—a clean and uniform product.

Root Disease and Replanting

EVEN ON THE RESTRICTED SUBJECT of the control of root disease in replanting, from the time of clearing, through the period of immaturity of the new stand, this article cannot claim to be the last word. Soil-borne diseases pose problems which take many years to solve. Meanwhile, the facts at present known are being used to revise some of the advice on control procedures given in the more general article on root disease in *Planters' Bulletin 10*, which appeared in January 1954. Because the evidence is incomplete and the conclusions drawn from it are therefore to some degree provisional, it is considered best to explain why the various recommendations have been given, and why it is found necessary to change some of them.

ESTABLISHED PROCEDURE

For many years the advised policy was basically to trace out and eradicate sources of infection, whenever and wherever they were found. In preparing an area for replanting, the extent of root infection was to be found by digging, starting at the margins of disease patches. The roots of all trees found infected were to be dug out and burned. Later, sources of infection were to be traced back from the young trees that became infected, for removal and burning. This policy was based on the observation that root disease spreads by contagion, a growing tree becoming infected when its roots make contact with diseased wood, usually an old stump or a fragment of root. Though spores are produced in abundance by the fruit bodies of the major root disease parasites, there is no evidence that they are able to infect a growing tree directly. They can however, invade timber or moribund trees from which the disease may, after a time, spread to healthy trees.

The method of treating root disease in a young stand took into account an observation made many years ago—that the three most important root diseases of rubber (*Fomes lignosus*, *Fomes noxius* and *Ganoderma pseudoferreum*) extend along the outside of an infected root ahead of where it is penetrated and killed. The habit is well developed only in white root disease (*F. lignosus*). As red root disease (*G. pseudoferrum*) and brown root disease (*F. noxius*) grow they produce a fungal skin over the outside of an attacked root. The external growth of white root disease, on the other hand is concentrated into root-like strands (the rhizomorphs) which advance more rapidly.

The fact of external growth ahead of penetration affects both the method of recognising root disease and of treating it. It is found that the crown of an infected tree may appear normal until the disease is far advanced. A tree is generally beyond saving by the time the foliage shows the effects of the roots having been killed. The desire to detect the disease at an earlier stage led to the introduction of tree-to-tree collar inspection, the tap root and bases of the lateral roots being periodically exposed in the hope of detecting the arrival of the fungus at

Root Disease and Replanting

the stage of external growth. Then, only the penetrated part of the root would need to be cut off; elsewhere the superficial growth would be stripped and scraped away and the underlying healthy root treated with a fungicide to destroy any fragments of mycelium remaining.

By routine tree-to-tree collar inspection, followed by treatment of attacked trees, tracing out sources of infection for removal and burning, root disease undoubtedly can be eliminated from a replanting. Taking into account only the basic fact of spread by contagion, no other course appears possible. Yet, as more becomes known of the diseases, it is found that not all the operations that were advised are necessary or even helpful.

Shortage of money and labour under post-war conditions necessitated economies in control measures. As a result, the eradication of diseased trees from an old stand prior to replanting was often not attempted. Later on, in the replanting, routine collar inspection was usually dispensed with, as was the practice of eradicating sources of disease remaining from the old stand. On many estates the work on root disease was cut down to the barest minimum; sometimes the urgent need to economise led to the adoption of practices which gave little benefit in the long run.

TWO FIELD EXPERIMENTS

The changed situation led us to investigate ways in which the advice which had become less practicable could be simplified without failing in the ultimate objective of giving a replanted stand free from root infection. One experiment compared three methods of control. Some plots received the full programme of periodic collar inspection, treatment of attacked trees and eradication of sources of infection, as described above. At the same time, other plots received a like treatment, but only in those cases where the canopy was affected, the collars not being inspected. The remaining plots were given no treatment of any kind. At the end of four years, when the experiment had to be terminated prematurely, the collars of all trees over the whole experimental area were inspected, to learn more about the spread of disease in the foliage-inspected and in the control plots. Surprisingly, the total incidence of infection was much about the same for all three treatments, the lowest figures being in the untreated plots in which, moreover, far fewer trees had been killed by root disease than had been removed from the treated plots.

The same treatments were repeated in another experiment, which has now reached the stage when the rate of infection is falling off to low level, making it possible to draw reliable conclusions. Here the incidence of infection has been highest where collar inspection and full treatment have been carried out; it is less where foliage inspection replaced collar inspection, and it is least of all in the absence of control measures.

Comparing full treatment with no treatment, the latter has resulted in half the incidence of root disease, and a third the losses, up to the seventh year. This is a result which cannot immediately be carried into our recommendations for control, for it appears to imply that control measures against root disease have no other effect than to make matters worse. But, against this, it must be borne in mind that the result applies strictly only to the place where the experiment was carried out. Furthermore, we have seen, in several non-experimental areas, the unfortunate effects of lack of root disease control. Some compromise is therefore needed.

FINDINGS FROM INOCULATION EXPERIMENTS

Certain observations which have emerged from other experiments, in which young trees have been artificially inoculated with white root disease, indicate ways in which these apparently contradictory findings may be reconciled. Firstly, wounds have been seen to be more readily penetrated than the intact part of the same root. Collar inspection inevitably causes wounds, which are not normally treated in any way. Secondly, the tree has some power of resistance which, in some circumstances, will result in the infection in the wood being cut off behind a protective barrier which the fungus has difficulty in penetrating. Thirdly, the rate of advance of the fungus is largely determined by the rate of its external growth along a root, being greatly slowed down if external growth can be prevented. Fourthly, a piece of infected wood, in order to infect a living tree, must be more than a certain minimum size. The factors determining whether an infection takes place are largely unknown, but it is found that a small inoculum, which would suffice to infect a young seedling, will fail with a large tree. Fifthly, mycelial growth of the fungus on the surface of buried sections of infected root will sometimes disappear even though the fungus is present within the wood and will again grow away if the piece of root is reburied elsewhere. The last four observations, taken together, suggest that the growth of *F. lignosus* in soil that remains undisturbed, as when root disease control is not carried out, may be slowly suppressed by the parasitism or antagonism of other soil organisms (which we have observed), hence weakening its attack to an extent that enables some infected trees to resist further penetration. This, however, is in the realm of surmise; but the harmful effects of wounding the roots are more sure.

REVISED ADVICE ON DETECTION AND TREATMENT

It is necessary to consider how these findings affect our recommendations for detecting root disease, treating diseased trees, and eradicating sources of infection prior to and following replanting. With regard to the first, we are convinced collar inspection should no longer be advised as a periodic routine. Apart from the indications that it has the

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undesirable effect of increasing the incidence of disease, it takes a considerable time to do, with the result that rounds of inspection are made infrequently and treatment is accordingly delayed. When looking only for gross changes in the canopy, a labourer can inspect tens of acres a day. Rounds of inspection and treatment can therefore be made more often, say once a quarter. Where a diseased tree is found, collar inspection can be employed to trace out the extent of spread of the disease along the planting row, continuing it until one or two trees have been found free of infection.

As for the treatment of diseased trees, the indications are that many would recover with no more assistance than having diseased roots pruned off. Evidence for this is not, however, conclusive. We would therefore advise, for the time being, continuing with the removal of superficial growths of the fungus, but would emphasise that the task need not be meticulously carried out. It is more important to avoid wounding the root than to get rid of every trace of fungal mycelium. The fragments that remain can be killed off by painting the root with one of the tar acid fungicides that form the bulk of the materials approved for the treatment of mouldy rot, using them at the higher concentration of the range given on page 69 of *Planters' Bulletin* 25. These materials have been found superior to 2% copper sulphate solution, hitherto recommended as being cheap and readily available. Any wounds caused in exposing or treating the roots should be given a protective dressing after applying the fungicide—tarring them being perhaps most convenient.

PRECAUTIONARY COLLAR INSPECTION

It is a good idea to put some distinctive mark on trees that have been treated for root disease, so that centres of infection will become increasingly clearly visible, making it easy later to concentrate control measures where they are needed. Further, at about the third or fourth year, whether root disease has shown up or not, it is suggested that a tree-to-tree collar inspection be made throughout the replanting on a sample basis, at first taking every third or fourth row and extending the inspection only if it found desirable to do so. This is to guard against the possibility of root disease in some places spreading slowly on to the trees and becoming extensively established before the death of any of them makes its presence known.

COVER PLANTS AND DECAY OF TIMBER

Before considering the question of eradicating sources of infection, certain general observations on the decay of rubber wood and the influence of cover plants are relevant. A poisoned rubber tree or stump decays rapidly. After a very few years, say between four and seven, the period depending on soil conditions and the nature of the cover, it will have disintegrated completely. Decay is most rapid where a dense cover

of a creeping legume is established. If, on the other hand, the soil is left largely exposed, the boles of the old trees harden and take longer to rot. It was found many years ago that the incidence of root disease in replantings is less under either a creeping legume or bush legume cover than under clean weeding. One factor involved is the increased rate of decay of timber which can harbour the root disease fungi, where a high moisture content maintained in the soil by the cover encourages a large variety of wood destroying organisms. Bush covers cannot be recommended with the same confidence as creepers in areas where root disease is serious, because they are not as efficient in hastening the decay of timber, and they are themselves susceptible to root infection. A well grown bush is capable of passing the infection on to a young rubber tree by root contact. Creepers apparently do not bring about infection in this way, probably because their roots are too small to be infective. On the other hand, white root disease spreads freely in the surface litter under a creeping legume and will quickly infect the base of the stem where vegetation has been allowed to grow round the trees, maintaining the high humidity which is necessary for growth of the fungal mycelium. In this situation penetration is rapid and the trees are quickly killed. It is important, therefore, where white root disease is present, to keep the covers back from the trees.

ERADICATING DISEASED STUMPS

If the method can be made to work, it is clearly better to encourage the old diseased stumps to decay rather than to dig them out and burn them. Since this point was first made, we have obtained supporting evidence from one experimental site. Carrying out only partial eradication, removing lateral roots and isolating the boles of old stumps found to be sources of infection, has been followed by no increase in disease incidence—the figures are actually lower with partial than with total eradication. For comparable evidence of the effect of different degrees of pre-planting eradication we shall have to wait several years for results to accumulate from current experiments. Meanwhile, it seems reasonable to continue to advise, where pre-planting eradication is being done, limiting it to those diseased trees that lie close to what will be the new planting rows.

MECHANICAL CLEARING

The method of clearing an area for replanting can have a profound effect on the future incidence of root disease. Mechanical clearing with heavy equipment deserves special mention. The usual method is to fell by treedozer blade or by a cable between two track-laying tractors, to use bulldozers for the stacking and restacking necessary to get a complete burn; then with tractors, to draw heavy tines through the soil to cut up the roots and bring them to surface where they are collected by hand; finally to plough and harrow the area. If all this is done, the

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timber left in the ground will mostly be scattered fragments which will quickly rot away. There will be some larger pieces, such as the tap roots of diseased trees, which will snap off and will not be removed by later operations, but these are isolated points. It is not surprising that root disease in the replanting of a mechanically cleared area starts sooner than after other method of clearing, and is sooner finished. The method, therefore, is satisfactory from the point of view of root disease control, though its merits on general agricultural grounds may be questioned. However, the expense of mechanical clearing is large and cannot be justified solely as a measure of root disease control. It is cheaper to clear by felling and stump poisoning, or by tree poisoning, and to deal with the disease as it shows up in the replanting. The one great merit of mechanical clearing is that it enables an estate to proceed with replanting much faster than would be possible if all operations had to be carried out by hand. Not only can the clearing be done on contract but, once the area has been cleared in the manner described, later operations are facilitated and some of them can be mechanised.

TREE AND STUMP POISONING

In the only completed experiment comparing the effects of poisoning standing trees and of felling and poisoning the stumps, on subsequent root disease incidence in a replanted stand, tree poisoning gave a markedly better result. The effect of stump poisoning was, however, somewhat masked by the spread of disease in unburnt timber left lying on the ground, in the manner described in the article 'Decaying Timber Spreads Root Disease' in *Planters' Bulletin* 29, page 31. Because of this, we would advise burning heavy timber in a felled area, where it is not being carted away for firewood. The timber that falls as a poisoned tree disintegrates, being already well penetrated by harmless organisms, is no longer open to invasion by the root disease parasites. However, many planters reject tree poisoning as a method of clearing on the grounds that clearing up the fallen wood, and making good the damage done to the young plants, brings the cost up to that of other methods of clearing. There are, however, ways of minimising the damage: by pulling the larger branches down after they have become sufficiently rotten but not too decayed, or even to pushing the entire tree over, using a bulldozer with overhead protection for the driver. Further, if unselected seedlings are planted for budding in the field, and the timber of the old stand is disposed of before they are cut back, damage to the young plants is not serious.

PREVENTING INVASION OF UNINFECTED STUMPS

An aspect of root disease control that cannot be too strongly emphasised is the importance of checking, as far as possible, the spread of disease into the root systems of trees which were healthy when they were felled. Poisoning stumps with sodium arsenite has been proved to

be valuable for this purpose. For maximum effect it should be done immediately after felling. Treating the cut surfaces of stumps with a wood preservative, without poisoning them, also has shown some effect. In one replanting experiment, fewer of the treated stumps became sources of infection than of those left untreated, though the effect was less than that of poisoning. The treatment was applied with the object of preventing spore colonisation of the cut (which has been demonstrated to occur, though it is not known how significant it is) and it must be supposed to have succeeded at least to some degree. Is it, then, reasonable to adopt a policy of treating the cut surfaces when poisoning stumps? This is a question which we must leave open until we have direct evidence of the effect of surface treatment on poisoned stumps. Even quite a small effect would justify the extra treatment. If no more than two or three stumps per acre were thereby prevented from becoming sources of infection later on, the small additional cost of stump treatment would be recovered in the saving on root disease control in the replanting. When poisoning stumps with sodium arsenite, it would be a simple matter to continue the application of poison over the cut instead of confining it to the ring-barked band round the top. If this were found to have the desired effect, it might be preferred to applying creosote, which we already have under test.

Just as there is a danger of encouraging the spread of root disease in a replanting by leaving unpoisoned stumps in the ground, so too there is a danger in leaving the stumps of thinned-out trees untreated. Where this is done it is not uncommon to find neighbouring trees becoming infected by root contact with the stumps, which have become infected by wind-borne spores. In thinning, the same precautions should be applied as when clearing the old stand. If the trees cannot be removed completely, they should be poisoned standing or their stumps poisoned. Poisoning entails some risk of local injury or even death of neighbouring trees, by translocation of the poison through grafted roots, but the risk is small when trees are poisoned with 2,4,5-T (as described in *Planters' Bulletin* 33, page 104) or when stumps are ring-barked and poisoned with sodium arsenite paste.

CONTROL DURING IMMATURITY

When following the policy of leaving sources of infection to decay, it is the more important to ensure that root disease is prevented from becoming established on the young trees. If this is not done, the disease will continue to spread, in time giving rise to root disease patches that are so familiar a sight in old rubber, and are too often seen in young mature rubber.* The aim should be to have root disease under control by the time a young stand is brought into tapping. Though vigilance may be needed for several years more, the number of trees to be treated will be small and, the stand having reached the desired level, every effort should be made to save them.

Firewood for Smokehouses

CONSEQUENT ON IMPROVEMENTS IN PLANTING MATERIAL giving ever increasing yields of rubber, it has been necessary to increase the capacity of drying facilities, which has in turn led to greater demands for firewood. But supplies of firewood are becoming less where the rate of replanting is slowing down after intensive efforts to replant low yielding areas. In the near future the position will be further aggravated because the budded rubber that will increasingly be cut out gives a lower yield of firewood per acre than seedling trees. The necessity has therefore arisen of devising methods using the minimum quantity of firewood to produce sheet rubber which is acceptable to the market as smoked sheet.

It is informative before considering these methods to have a brief look at the firewood requirements for normal smoking. The average consumption of a modern smokehouse is about 1 cu. yd of stacked firewood per 1,000 lb of rubber. This will vary according to the design of the smokehouse and the way in which it is operated, as well as to the quality of the wood, in particular, its water content. Figures as low as $\frac{1}{2}$ cu. yd and as high as 2 cu. yd have been reported. Whereas old seedling rubber gives about 150 cu. yd of firewood per acre, budded rubber may yield as little as half this amount. Taking an area of 100 acres yielding 100,000 lb of rubber per year, the average firewood requirement would be 100 cu. yd of firewood per year. At 75 cu. yd per acre, the area required to be felled would be $1\frac{1}{3}$ acres per year. On the basis of an evenly spread progressive replanting policy, allowing for the felling of about 3% of the planted area per year, firewood requirements should be adequate. However, an uneven replanting rate and the difficulty of storing the wood for long periods can make the problem of firewood supply acute.

The problem has been studied from a number of angles. The first approach was to give the wet rubber one day in the smokehouse and then transfer it to an air drying shed for the remainder of the drying time (about three days). Air drying sheds can be heated by steam from an oil-fired boiler or by circulating the air through an oil-fired heat exchanger. By these means the firewood consumption can be cut by about two thirds. Extensive trials on our Experiment Station have shown that rubber dried in this way is not in any way inferior in its technological properties to normally smoked sheet, but the resistance to mould growth is not as good. Treatment with a solution of para-nitrophenol (*Planters' Bulletin* 8, page 107) corrects this defect.

Another method is to air dry for three days and then smoke for a final day. This has ancillary advantages. Firstly, less heat is needed in the final day of drying than in the first day; thus firewood consumption is further reduced. Secondly, if air drying sheds are being installed, the producer may wish to take advantage of the market which exists for air dried sheet, which must not receive any smoking and, in particular, must not have any suggestion of a 'smoky' smell. If smoking is done on

the final day, there is no chance of the air drying sheds being contaminated with smoked rubber.

Consideration has also been given to introducing smoke into a drying shed heated by oil fuel. One such drying shed which is well established is the G.E.C. tunnel drier, similar to the prototype described in the guest article in *Planters' Bulletin* 24, page 45. A method of introducing smoke into the recirculation duct has been tested by the G.E.C. who have informed us that satisfactory operation has been obtained. Using this method, smoking is carried out for say six hours each day, and the firewood consumption is of the order of only 0.1 cu. yd per 1,000 lb of rubber.

A completely different approach to the problem is to find a chemical which, added to latex, will produce the desired effects of smoking without the necessity of drying in an atmosphere of smoke. Examples of this type of material are Fumeol and Gaudrons Désacidifiés (an impure Fumeol) which are used in the fish industry. When they are used with latex, the resultant sheet is darker than air dried sheet; but we have found that no mould resistance is imparted, and the appearance is dull. A further proprietary material known as the Mac & Lai Additive has recently become available in trial quantities, and we have carried out limited tests on rubber prepared by the recommended process. The resultant sheet had an appearance somewhat similar to smoked sheet, was not inferior in the technological properties that were examined, and had good mould resistance. It did not, however, smell of smoke products and for this reason there may be some market prejudice against this type of sheet.

Conditions vary so widely on estates that detailed recommendations are difficult to give in a note such as this, but we can summarise the principal considerations involved. The criteria against which 'smoked sheet' is judged by the buyer are (apart from defects such as rust, bubbles etc) colour, smell, and freedom from mould. If a sheet is free from mould, a darkish colour and a smoky smell indicate that mould is unlikely to develop rapidly during storage. These are reasonable criteria only if it is assumed that no chemicals are added which, though not detectable by sight or smell, give a mould resisting sheet. The requirements are mould resistance and freedom from technological defects. However, the appeal of the product on the market is affected unless the smell and colour approach the normal. An acceptable smell and colour can usually be obtained by smoking for about a quarter of the drying period. The producer, however, must take precautions to ensure that mould does not develop on the rubber, and special attention must be paid to thorough drying and packing of the sheet under low humidity conditions. A para-nitrophenol dip is also a wise precaution, for in none of the cases which have been investigated is the mould resistance of partly smoked sheet quite as good as fully smoked sheet. Tests at the R.R.I. have not revealed any deleterious effects of para-nitrophenol on the technological properties of the rubber.

Firewood consumption can be greatly reduced by using partial smoking, the balance of the heat requirements being supplied from oil fuel. But, where firewood is freely available, normal smoking is cheaper, and conversion to air drying is justified only if there is a desire to make fully air dried sheet for a special market. Chemicals such as the Mac & Lai Additive may eventually make possible the elimination of smoking, but full market approval of the resulting product has still to be secured.

Bark-Eating Caterpillars

An infestation of caterpillars, hitherto undescribed on rubber, was encountered recently on an estate in the coastal district of Selangor. Large numbers of them were feeding on the bark of PB 86 trees three years old, all over the stem and main branches. The trees were not being appreciably damaged as the caterpillars were feeding only on the outer bark, in places exposing the green cortex and causing a few spots of latex to exude. Almost every tree over an area of 50 acres was attacked, the most heavily infested

having about a hundred of the pests on them.

Each caterpillar constructs a curved conical shelter with its broad end downwards and a narrow crest along its middle line, attached to the tree except at the lower end where the caterpillar protrudes its head to feed. The pupa forms within a swelling at the lower end of the shelter, and from it emerges a small white moth with dark brown patches on the front wings.

Another bark-eating caterpillar which has occasionally been seen on the lower part of the stem of young trees, constructs a flat shelter in the form of an irregular sheet, beneath which it feeds.



Stem of a young budded tree attacked by bark-eating caterpillars ($\frac{2}{3} \times$ linear).



Base of the stem of a young seedling tree attacked by bark-eating caterpillars ($\frac{1}{2} \times$ linear).

Superior Processing Rubber

SP smoked sheet has made considerable progress during 1957. From a total output of less than eleven tons in 1956, the average monthly shipments during the four quarters of 1957 were 5, 9, 23 and 34 tons. Total production in 1957 was 240 tons, of which 40% was made by Messrs Harrison & Crosfield (Malaya) Limited, the remainder by the R.R.I.

Late in November the Natural Rubber Development Board, using data supplied by the British Rubber Producers' Research Association, published a technical bulletin entitled 'SP Rubber', which is in course of distribution to every important rubber manufacturer in the world. This bulletin describes in both graphical and technical terms the special processing attributes of SP rubber. Stocks of each of the three kinds of SP rubber are ready in London, New York, Paris, Genoa, Tokyo, Melbourne, Cape Town and in New Zealand, to supply initial samples immediately they are requested.

SP crepe continues to be produced by The East Asiatic Company at their Taiping factory. Production in 1957 was 70 tons, but we understand that a considerably increased output is expected in 1958, to satisfy a growing demand for this new rubber.

SP air dried sheet has been made only at our Experiment Station, from which we shipped 27 tons in 1957. It was expected that this kind of SP rubber might be of interest to manufacturers of light coloured goods, where the darker smoked sheet could not be used.

The formulation of the vulcanised portion of the SP rubber has been successfully modified to reduce the cost of production. Our efforts are now concentrated upon introducing superior processing properties into lower grade rubbers. We have succeeded in making estate brown and remilled grades with SP properties on a small scale, and we are now making trial quantities for shipment and evaluation by manufacturers. If these trials come to a successful conclusion, SP rubbers will have a much wider field of application.

Mouldy Rot Fungicide

Planters' Bulletin 25 includes, on page 69, a list of fungicides that have been officially approved for the treatment of mouldy rot. There has since been one addition: Sanitas Okol, a water miscible tar acid fungicide produced by the Sanitas Company Limited, of London, whose local agents are the Anglo-Thai Corporation Limited, of Singapore. It reached the standard required in our tests when used at a concentration of 30%, which is also the upper limit that is safe to apply. At higher concentrations the newly tapped bark may be damaged.

Powers Samas Installation

Powers Samas punched card machinery has been installed in the Statistics Section of the Institute. Detailed information from field experiments and surveys is now recorded on cards, which can be passed through the machines at great speed, summarising and extracting the data contained on them.

Manuring Programme for Young Replantings

A MANURING PROGRAMME for young replantings on inland soil types was published in *Planters' Bulletin* 9, issued in November 1953. This was intended to be only a general guide, not necessarily to be followed rigidly at all times and in all places. We find, however, that there has been a tendency to give fertiliser treatments strictly in accordance with this schedule, without taking into consideration the variation in rate of growth and general condition of the young trees in different areas.

Provision was made for what was considered to be the minimum fertiliser requirement for optimum growth, but, to judge from observations made in the past few years, it would appear that the treatment is inadequate for the majority of replantings. Recent results from manuring experiments have shown that growth can be further accelerated by increasing the frequency of applications, particularly in the first and second years after planting. We therefore submit a revised schedule of manuring which can be expected to give good results in replantings on most inland soil types.

If basket plants are to be planted, about $\frac{1}{8}$ oz, or a level teaspoonful, of rock phosphate may be mixed with the whole of the soil in the basket before planting the germinated seed. Well rotted cow dung or

SCHEDULE OF MANURING (INLAND SOILS)

Time of application	Fertiliser mixture		Quantity per point	
	Loams and clay loams	Very sandy soils		
Seedlings and basket plants				
In planting hole	Rock phosphate		4 oz	
2 months	} after planting	M	X	4 oz
5 months		M	X	4 oz
8 months		M	X	6 oz
Field budgrafts and budded stumps				
4 months	} after budding	M	X	4 oz
8 months		M	X	6 oz
Clonal seedlings and budgrafts				
12 months	} after planting or budding	M	X	8 oz
18 months		M	X	8 oz
24 months		M	X	12 oz
30 months		M	X	12 oz
36 months		M	X	24 oz
48 months		C	Y	32 oz
60 months	C	Y	32 oz	

COMPOSITION OF FERTILISER MIXTURES

Mixture	Sulphate of ammonia (21% N)	Christmas Is. rock phosphate (36-38% P_2O_5)	Muriate of potash (60% K_2O)	N %	P_2O_5 %	K_2O %
M	47	47	6	9.9	17.4	3.6
C	65	35	—	13.6	12.9	—
X	44	42	14	9.2	15.5	8.4
Y	56	30	14	11.8	11.1	8.4

compost may also be added if readily available on the estate; equal parts of cow dung (or compost) and soil, with the appropriate amount of rock phosphate, should be well mixed before filling the basket. The need for thorough mixing of the rock phosphate with the top 6 to 8 inches of soil in the planting hole just before planting is emphasised. There is ample evidence to show that this initial application of the phosphate in the planting hole has a marked beneficial effect, and uneven distribution within the zone occupied by the newly developed roots may result in retarded development in the initial stages.

The recommended method of applying fertilisers after planting is described in *Planters' Bulletin 23*. Attention is drawn to the need for careful supervision of the first application, two months after planting. The fertiliser must be distributed uniformly over a circular area about 18 inches in diameter immediately around the base of the young plants. Heavy concentration within a restricted space in the root zone must be avoided at this stage in particular, as it may cause severe scorching of leaves and may even kill the weaker plants.

Though the programme recommended is suitable for most inland replantings, there will be exceptions. Soils in some areas may be deficient in essential nutrient elements besides nitrogen, phosphorus and potassium, the one most likely to be found deficient being magnesium. If this is in short supply the characteristic leaf symptoms of the deficiency develop readily and are easily identified, and the manuring programme should be modified to include magnesium. We would recommend one application of magnesium limestone at the rate of 8 oz per plant, broadcast uniformly over the cleared spaces along planting rows, and the standard programme should be continued using the corresponding magnesium mixtures instead of those listed in the schedule for the appropriate soil type and age of plants (thus, for Mixture M, substitute Magnesium Mixture M). In case of doubt advice should be sought from the R.R.I.

Symptoms of deficiency of nutrients other than magnesium cannot always be identified with certainty by visual inspection in the field. It is, therefore, advisable to have other suspected deficiencies confirmed by leaf analysis before any special treatment is applied. If it happens that the leaves of several rubber plants within an area show abnormal colour

Manuring Programme for Young Replantings

patterns, samples should be sent to the R.R.I. following the instructions given on page 21 of *Planters' Bulletin* 4.

MANURING OF YOUNG REPLANTINGS ON COASTAL ALLUVIAL SOILS

We are still not in a position to give firm recommendations for manuring young replantings on coastal alluvial soils. In many of these areas it is doubtful whether any response to fertiliser treatment will be obtained; but the fertility status of these alluvial soils does vary and there may be some which will benefit from manuring, depending on the previous history of cultivation and on the nature of the soil. With the information available at the moment, we do not feel justified in recommending a standard manuring programme for the coastal alluvial soils. Instead, it is suggested that planters should carry out the following simple manuring trial in their replanting, to find out whether a response to fertiliser treatment can be detected.

As a precautionary measure we recommend an application of rock phosphate just before planting, at the rate of 4 oz per point, mixed with the top 6 to 8 inches of soil in the planting hole, as for replantings on inland soils. This treatment costs very little; it can do no harm, and it may have a beneficial effect in some if not in all areas.

After planting we suggest that alternate rows be manured with sulphate of ammonia in the first year. The dressings recommended are 2, 3 and 6 oz per point at two, five and eight months respectively after planting. The treated and untreated rows should then be compared at intervals during the first year of growth. If it becomes evident during the first few months that the young plants are responding to fertiliser treatment, the whole area should then be manured and the programme continued in the second and subsequent years using sulphate of ammonia only. This is a provisional recommendation, pending further results from experiments in progress.

R. R. I. News

We were represented at the Ninth Pacific Science Congress by Dr P.R. Wycherley and Mr G.W. Drake. Three R.R.I. contributions, including his own, were presented by Dr Wycherley at symposia in the divisions of botany and entomology. Mr Drake presented his contribution to the chemical section dealing with natural rubber, gums and resins.

The Malayan delegates to the

'Symposium on Phytochemistry' held last December included three R. R. I. Officers: Dr S. G. Boatman, Mr G.F.J. Moir and Mr D.H. Taysum. The Symposium, jointly sponsored by the Government of the Federation and UNESCO, was held in the offices of the Department of Chemistry at Petaling Jaya. Delegates attended from eleven countries in Southeast Asia and Australasia. One of the excursions arranged for them was a visit to our Experiment Station.

R.R.I. Experiment Station

Availability of Budwood

Budwood of the following clones can be obtained from the Manager, R.R.I. Experiment Station, Sungei Buloh, Selangor (telephone Kepong 220) at \$5 per yard f.o.r. Sungei Buloh.

Subject to an agreement prohibiting resale – RRIM 600 series clones* and certain foreign clones including GT 1.

Free clones – LCB 1320, RRIM 501, 513, 519* and 526.

We do not supply other free clones, such as Gl 1, PR 107 and Tjir 1, to estates; these clones should be obtained from commercial sources. Proprietary clones, such as the Chemara and Prang Besar series, must be obtained from the companies concerned.

Orders are usually limited to nucleus quantities of each clone. Though larger orders can occasionally be entertained, it is not our policy to supply estates with budwood for large scale field budding.

* *Budwood of clones RRIM 519, 600, 607, 613, 614 and 615 will not be available until August, but orders are being accepted by the Manager, for delivery later.*

OUR COVER SHOWS THE STRAIN TEST
FOR THE TECHNICAL CLASSIFICATION
OF NATURAL RUBBER, DESCRIBED IN
THIS ISSUE.

